CH. 11 LAB: ELECTROLYSIS OF COMPOUNDS

PART 1: THE ELECTROLYSIS OF WATER – OBSERVING A CHEMICAL REACTION AND LEARNING ABOUT pH

Objective: To observe an electrolysis reaction and determine how the products affect the pH of the solution.

Background: When an electric current is passed through an aqueous solution containing an electrolyte (NaCl), the water molecules break apart or decompose into their elements, hydrogen and oxygen:

$2H_2O \rightarrow 2H_2 + O_2$

This reaction can also be written as 2 half-reactions:

At the cathode: $4e^- + 4H_2O \rightarrow 2H_2 + 4OH^-$

At the anode: $2H_2O \rightarrow O_2\ (g) + 4H^+ + 4e^-$

Element hydrogen (H_2) occurs at the cathode, while elemental oxygen (O_2) occurs at the anode. At the cathode, the OH^- produced will cause the pH to increase, resulting in a color change of the universal indicator solution. At the anode, the H^+ produced will cause the pH to decrease, resulting in a change of the universal indicator solution.

pH	Color
4	Red
5	Orange
6	Yellow
7	Green
8	Blue/green
9	Dark blue
10	purple

Procedure:

1. Fill your Petri dish 2/3 of the way with distilled water.

2. Prepare your source of electricity: Attach an alligator clip from one of the insulated wires to the positive terminal off the battery and an alligator clip from the other insulated wire to the negative terminal of the battery. Then connect the other alligator clip from each of the insulated wires (separately) to one end of each of the pencil leads. The lead (graphite) at the other end of the each pencil will ere as the electrode (surface) at which the electrolysis will take place.

3. Once you place the electrodes in the water, you will have a gap between them and you will need something to carry the electricity across that gap. Water itself is not a good carrier of electrical current, so you will have to add an appropriate courier: That will be sodium chloride. Sprinkle one small spatula-full of this substance into the water and stir to dissolve it.

4. In order to gain some insight into what is going on at each electrode, add enough Universal Indicator to the water to give it a distinct coloration and stir it to mix homogeneously.

5. Place the free ends of the two pencils on opposite sides of each other in the Petri dish. If your battery is good, things should start to happen in just a few seconds; if not, get a new battery.

6. Make observations of what is happening at each electrode and, from these, make a guess at what is being formed at each.

   Remember that electrolysis not only breaks down water into the elements hydrogen and oxygen, but it also breaks it down into the acidic (H^+) and basic (OH^-) components that combine to form neutral water. Wherever hydrogen is formed, the water will become basic and wherever, oxygen is formed, the water will become acidic.

7. Once you have made your identifications, trace back to the battery and determine which terminal is producing which element.

Color of solution	**Acidic or basic?**	**What is being produced there?**	**Which terminal? (anode or cathode)**

Analysis:

1. Why is there bubbling at each electrode? What product do the bubbles represent?

2. What kind of chemical reaction is the electrolysis of water? Why?

3. Why is electricity needed to produce the electrolysis reaction?

4. Why is NaCl added to the water?

PART 2: ELECTROLYSIS OF BINARY COMPOUNDS

Objective: You will analyze several binary salts, which are ionic compounds made of simple combinations of metals and nonmetals, and predict the products formed at each electrode.

Materials: reaction well plate
Copper (II) chloride
Silver nitrate
Iron (III) chloride
Lead (II) nitrate
9V battery and alligator clips

Procedure:

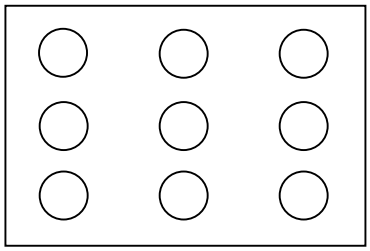
1. Find the beakers containing the solutions of each compound above, and place 2-3 droppersful of each solution in a separate well of the reaction well plate. NOTE: IT IS VERY IMPORTANT THAT YOU KEEP TRACK OF WHICH SOLUTION IS IN WHICH WELL.

2. Starting at one well, insert your electrodes attached to your battery and observe the reaction. Predict the products formed at each electrode and record in the data table. Run each reaction for a few minutes to accumulate a visible portion of product on your electrode. CLEAN ELECTRODES THOROUGHLY BETWEEN WELLS TO AVOID CONTAMINATION.

3. Dispose of solid metals with paper towels to the proper containers as instructed by Mrs. Simpson. DO NOT WASH SOLIDS DOWN THE SINKS.

4. The solutions can be rinsed down the sink. Wash and dry the reaction well plate carefully and leave at your lab station on the counter.

DATA AND OBSERVATIONS:



well #	Product at anode	Product at cathode

ANALYSIS AND CONCLUSIONS:

1. For each well, write the chemical reaction that took place.

2. What type of chemical reactions occurred in this lab? How do you know?

3. Why was energy, in the form of electricity, needed to complete these reactions?